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(54) **SYSTEM AND METHOD FOR PROGRAMMING NEUROSTIMULATION DEVICES USING CACHED PLUG-IN SOFTWARE DRIVERS**

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(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,168,871	A	12/1992	Grevious
6,236,917	B1	5/2001	Liebl et al.
6,580,948	B2	6/2003	Haupert et al.
6,839,650	B2	1/2005	Martin et al.
6,895,280	B2	5/2005	Meadows et al.
7,209,790	B2	4/2007	Thompson et al.

(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 13/474,237, Non Final Office Action mailed Jul. 30, 2013, 7 pgs.

(Continued)

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(57) **ABSTRACT**

A system for programming a plurality of different models, or generations, of neurostimulation devices includes a plurality of plug in software drivers stored on a hard drive of the system, wherein the plurality of plug-in software drivers are respectively configured for facilitating communication between the plurality of different models of neurostimulation devices and the system processor via a transceiver. In a method of programming a plurality of different models of neurostimulation devices, the system processor dynamically identifies the model of an interrogated neurostimulator and determines which plug-in software driver to use for programming the interrogated neurostimulator. The plug-in software drivers are cached into memory upon start-up of the system.

18 Claims, 5 Drawing Sheets
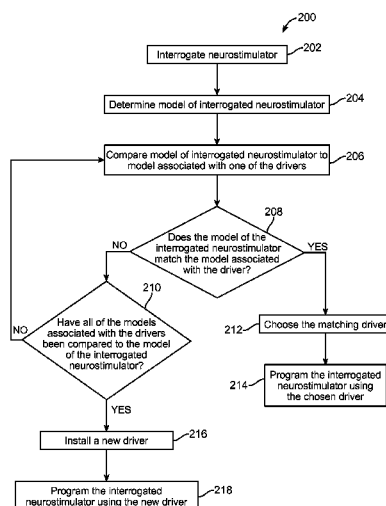
(56) **References Cited**

U.S. PATENT DOCUMENTS

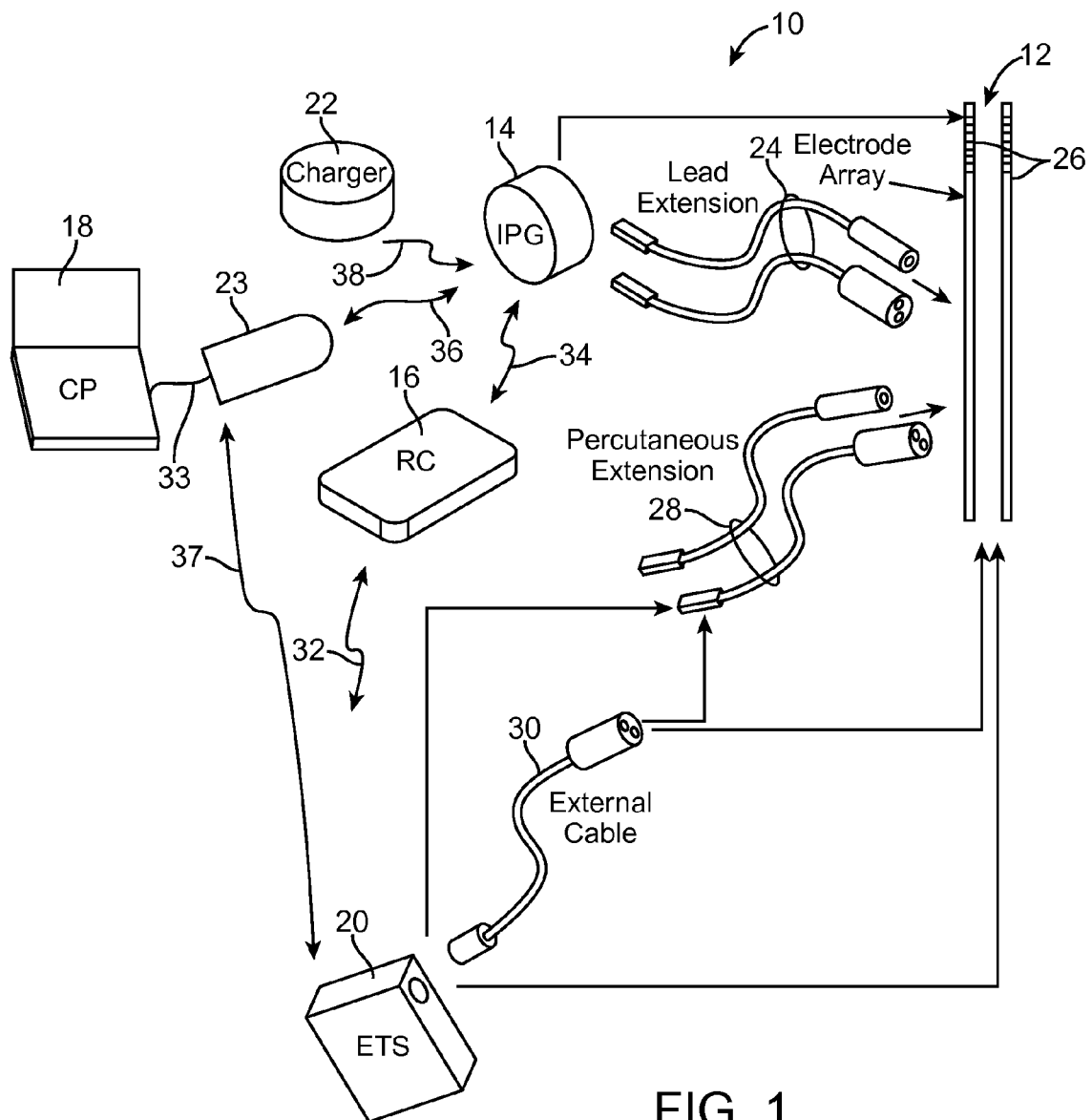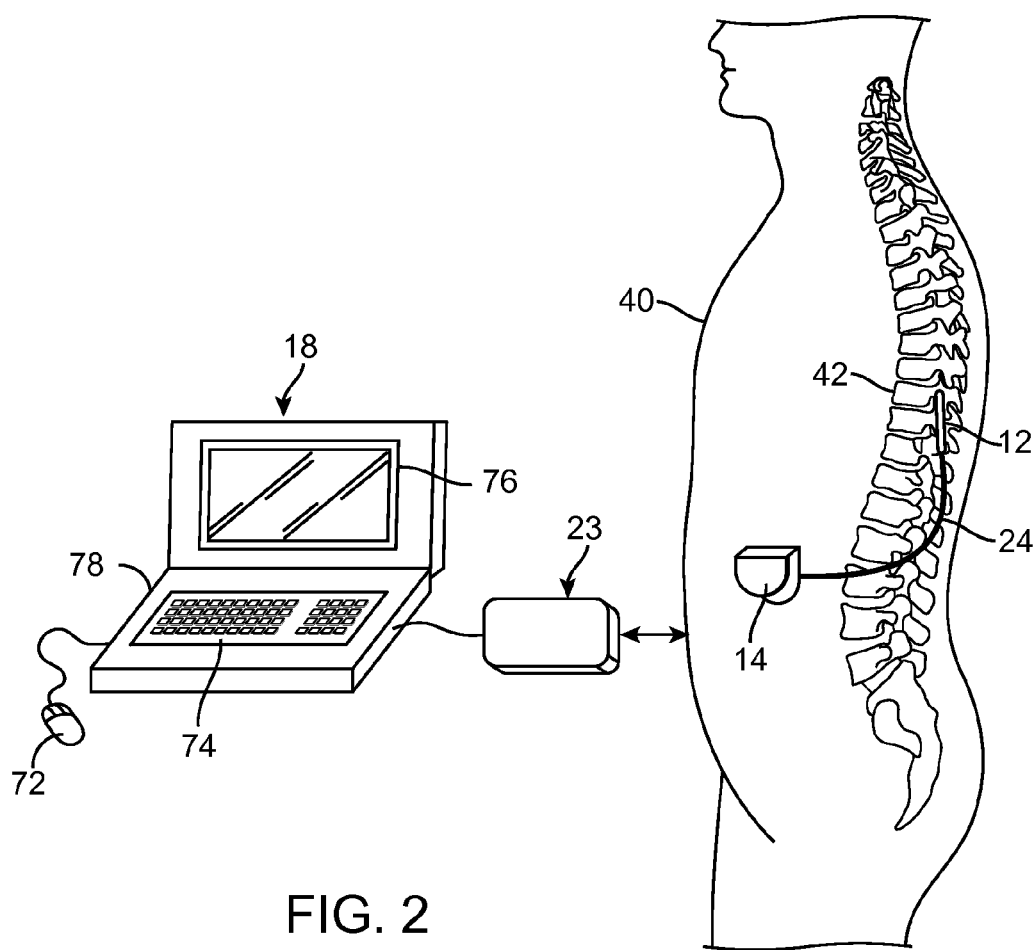|			
7,894,843	B2	2/2011	Smart et al.
8,805,506	B2	8/2014	Vansickle
2003/0028226	A1	2/2003	Thompson et al.
2007/0055324	A1	3/2007	Thompson et al.
2009/0216306	A1	8/2009	Barker
2010/0010566	A1	1/2010	Thacker et al.
2010/0083122	A1	4/2010	Kozloski et al.
2010/0121409	A1	5/2010	Kothandaraman et al.

OTHER PUBLICATIONS

U.S. Appl. No. 13/474,237, Non Final Office Action mailed Nov. 26, 2013, 13 pgs.
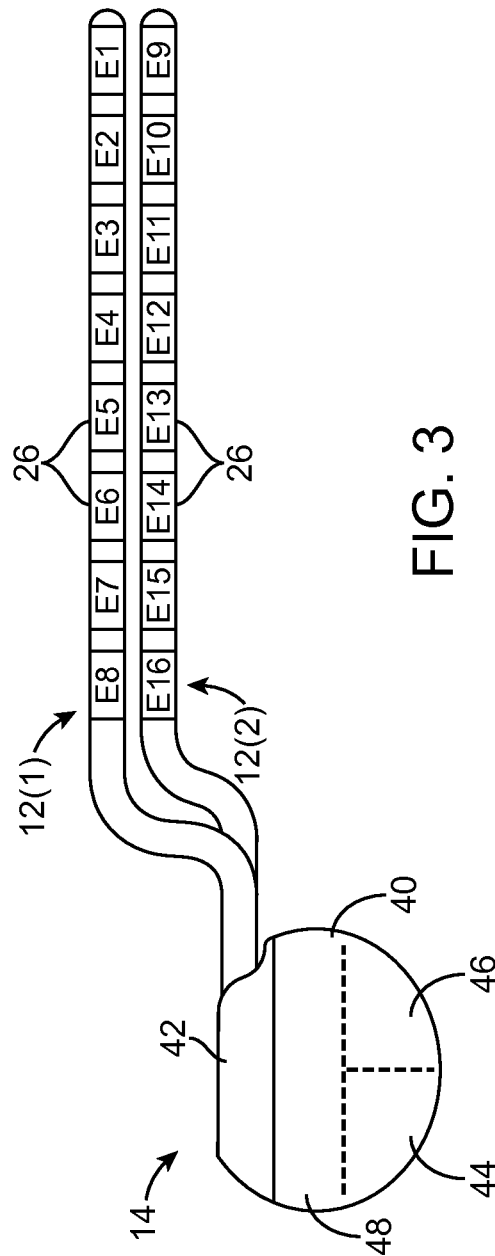
U.S. Appl. No. 13/474,237, Notice of Allowance mailed Apr. 1, 2014, 5 pgs.

U.S. Appl. No. 13/474,237, Response filed Feb. 4, 2014 to Non Final Office Action mailed Nov. 26, 2013, 11 pgs.

U.S. Appl. No. 13/474,237, Response filed Oct. 17, 2013 to Non Final Office Action mailed Jul. 30, 2013, 4 pgs.
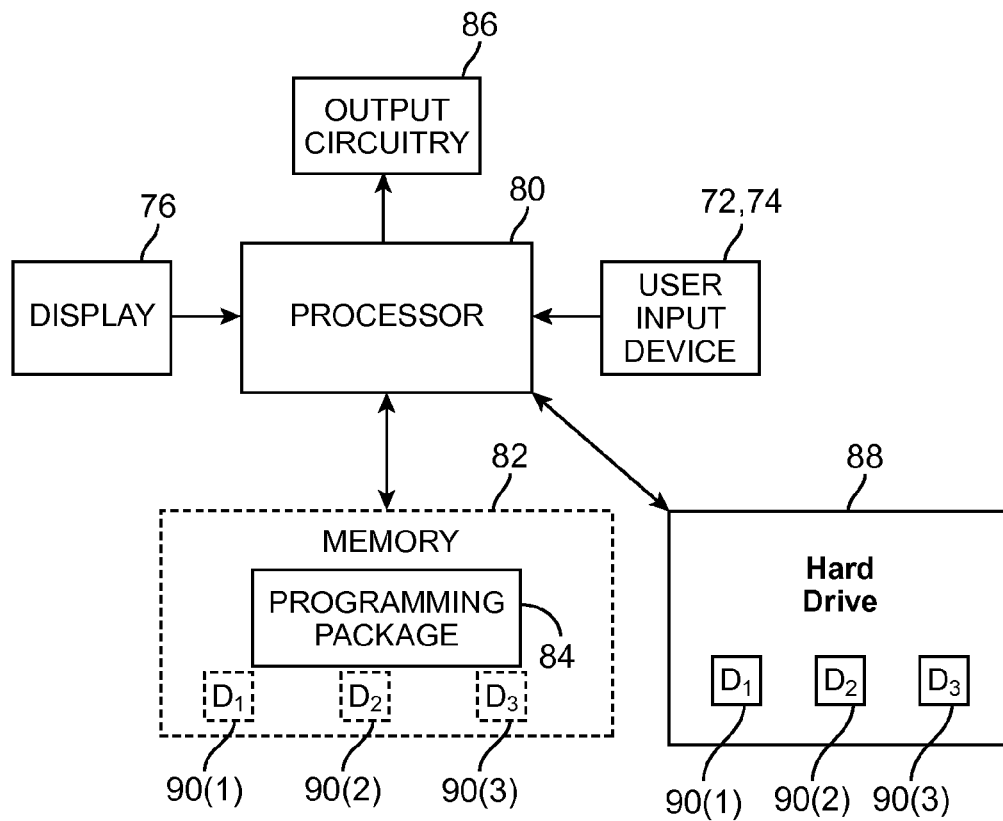
FIG. 1

FIG. 2

FIG. 3

FIG. 4

200

Interrogate neurostimulator — 202

Determine model of interrogated neurostimulator — 204

Compare model of interrogated neurostimulator to model associated with one of the drivers — 206

208

Does the model of the interrogated neurostimulator match the model associated with the driver?

NO   YES

210

Have all of the models associated with the drivers been compared to the model of the interrogated neurostimulator?

NO

YES

212 — Choose the matching driver

214 — Program the interrogated neurostimulator using the chosen driver

Install a new driver — 216

Program the interrogated neurostimulator using the new driver — 218
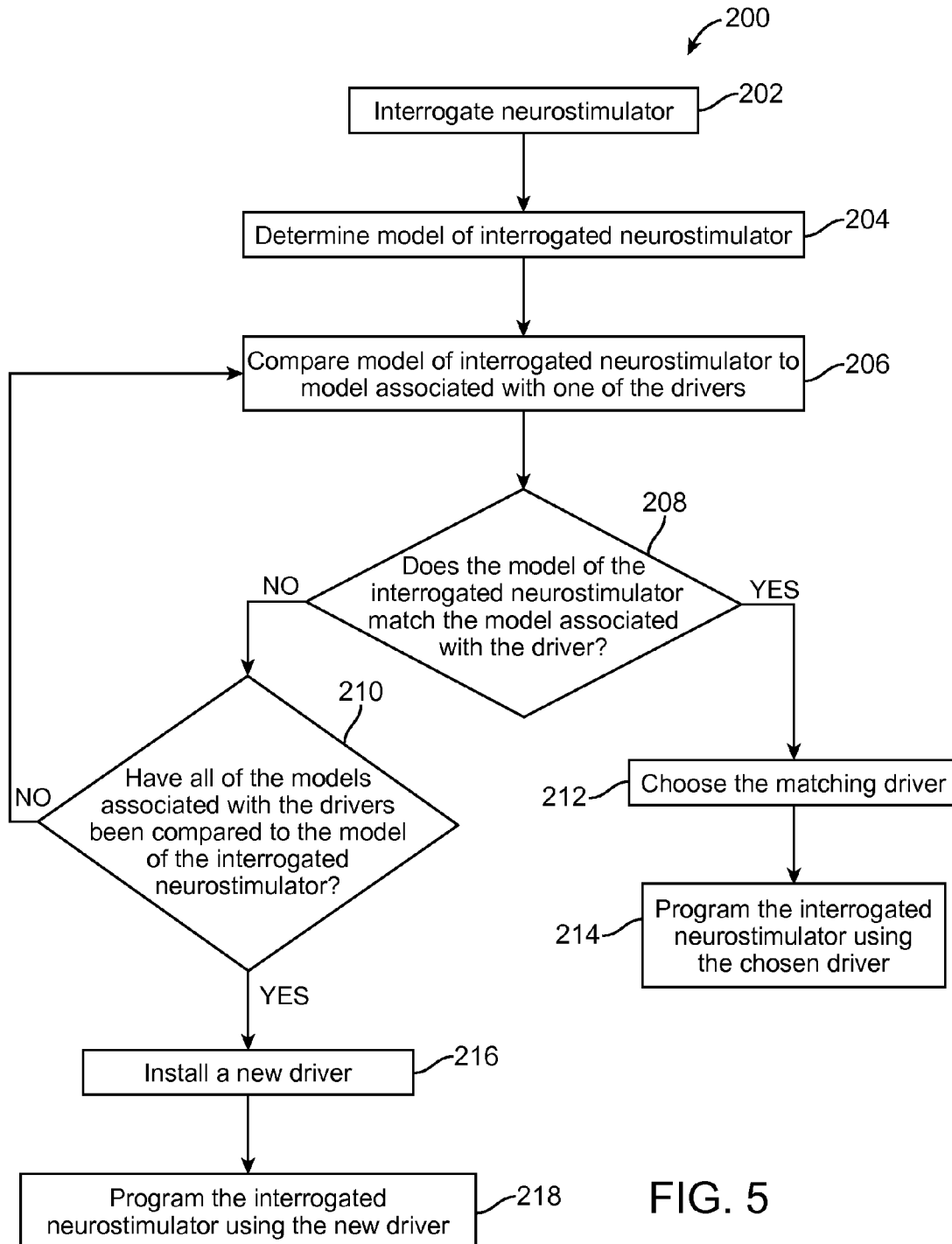
FIG. 5

SYSTEM AND METHOD FOR PROGRAMMING NEUROSTIMULATION DEVICES USING CACHED PLUG-IN SOFTWARE DRIVERS

RELATED APPLICATION DATA

The present application is a continuation of U.S. patent application Ser. No. 13/474,237, filed May 17, 2012, now issued as U.S. Pat. No. 8,805,506, which claims the benefit under 35 U.S.C. §119 to U.S. provisional patent application Ser. No. 61/488,726, filed on May 21, 2011, which applications are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to tissue stimulation systems, and more particularly, to a system and method for programming an implantable tissue stimulator.

BACKGROUND OF THE INVENTION

Implantable neurostimulation systems have proven therapeutic in a wide variety of diseases and disorders. Pacemakers and Implantable Cardiac Defibrillators (ICDs) have proven highly effective in the treatment of a number of cardiac conditions (e.g., arrhythmias). Spinal Cord Stimulation (SCS) systems have long been accepted as a therapeutic modality for the treatment of chronic pain syndromes, and the application of tissue stimulation has begun to expand to additional applications such as angina pectoralis and incontinence. Deep Brain Stimulation (DBS) has also been applied therapeutically for well over a decade for the treatment of refractory chronic pain syndromes, and DBS has also recently been applied in additional areas such as movement disorders and epilepsy. Further, in recent investigations Peripheral Nerve Stimulation (PNS) systems have demonstrated efficacy in the treatment of chronic pain syndromes and incontinence, and a number of additional applications are currently under investigation. Also, Functional Electrical Stimulation (FES) systems such as the Freehand system by NeuroControl (Cleveland, Ohio) have been applied to restore some functionality to paralyzed extremities in spinal cord injury patients.

These implantable neurostimulation systems typically include one or more electrode carrying neurostimulation leads, which are implanted at the desired stimulation site, and a neurostimulator (e.g., an implantable pulse generator (IPG)) implanted remotely from the stimulation site, but coupled either directly to the neurostimulation lead(s) or indirectly to the neurostimulation lead(s) via a lead extension. Thus, electrical pulses can be delivered from the neurostimulator to the neurostimulation leads to stimulate the tissue and provide the desired efficacious therapy to the patient. The neurostimulation system may further comprise a handheld patient programmer in the form of a remote control (RC) to remotely instruct the neurostimulator to generate electrical stimulation pulses in accordance with selected stimulation parameters. The RC may, itself, be programmed by a clinician, for example, by using a clinician's programmer (CP), which typically includes a general purpose computer, such as a laptop, with a programming software package installed thereon.

A clinician or physician may select between different models of neurostimulators to implant within the patient. Significant to the present inventions, each neurostimulation device model has its own programming software package. Thus, in order to be able to program a neurostimulation device, the

clinician has to know which model the device is and has to know which programming software is associated with that particular device. If the clinician does not have the appropriate software installed on the CP, the clinician is unable to program that device model. Thus, when a new neurostimulation device model is developed, the developer must ensure that the associated programming software package is distributed to every clinician that may need to interact with the new model of the device. Further, a newly developed neurostimulation device, as well as its associated programming software package, is subjected to rigorous review and validation procedures by the FDA and other such regulatory agencies.

Thus, there remains a need for an easier, more convenient way to update programming software packages for neurostimulation systems.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present inventions, a system for programming a plurality of different models of neurostimulation devices includes: a memory; a hard drive; a transceiver configured for transmitting data to and from the plurality of different models of neurostimulation devices; a plurality of plug-in software drivers stored on the hard drive; and a processor configured for caching the plurality of plug-in software drivers in the memory, wherein the plurality of plug-in software drivers are respectively configured for facilitating communication between the plurality of different models of neurostimulation devices and the processor via the transceiver. The processor may be configured for interrogating a neurostimulator via the transceiver and determining which one of the plurality of plug-in software drivers corresponds to the interrogated neurostimulator. The system may further include a user interface configured for allowing a user to program the plurality of different models of neurostimulation devices.

In accordance with a second aspect of the present inventions, a system for programming a plurality of different models of neurostimulation devices includes: a hard drive; a transceiver configured for transmitting data to and from the plurality of different models of neurostimulation devices; a plurality of plug-in software drivers stored on the hard drive, wherein the plurality of plug-in software drivers are respectively configured for communicating with the plurality of different models of neurostimulation devices via the transceiver; and a processor configured for interrogating a neurostimulator via the transceiver and for determining which one of the plurality of plug-in software drivers corresponds to the interrogated neurostimulator, wherein the interrogated neurostimulator is one of the different models of neurostimulation devices with which the drivers are configured to communicate. The system may also include a memory, and the processor may be configured for caching the plurality of plug-in software drivers in the memory. Still further, the system may include a user interface configured for allowing a user to program the plurality of different models of neurostimulation devices.

In accordance with a third aspect of the present inventions, a method for programming a plurality of different models of neurostimulation devices using a system comprising a plurality of plug-in software drivers is provided. The method includes interrogating a neurostimulator. Interrogating the neurostimulator may include accessing a hard drive of the neurostimulator and obtaining identifying information from the hard drive of the interrogated neurostimulator. Before

interrogating the neurostimulator, the method may include caching the plurality of plug-in software drivers into a memory of the system.

The method in accordance with the third aspect of the present inventions further includes: determining a model of the interrogated neurostimulator; based on the model of the neurostimulator, choosing one of the plug-in software drivers; and programming the interrogated neurostimulator using the chosen plug-in software driver. The method may further include using the chosen plug-in software driver to facilitate downloading information from the interrogated neurostimulator to the system.

Choosing one of the plug-in software drivers may include comparing the model of the interrogated neurostimulator to a model associated with each of the plug-in software drivers, wherein each of the plug-in software drivers is associated with a different model; determining that the model of the interrogated neurostimulator matches one of the models associated with one of the plug-in software drivers; and choosing the plug-in software driver associated with the matching model.

The method in accordance with the third aspect of the present inventions may further include: interrogating another neurostimulator; determining a model of the other interrogated neurostimulator; based on the model of the other interrogated neurostimulator, choosing another one of the plug-in software drivers; and programming the other interrogated neurostimulator via the other chosen plug-in software driver.

Still further, the method in accordance with the third aspect of the present inventions may include: interrogating another neurostimulator; determining a model of the other interrogated neurostimulator; comparing the model of the other interrogated neurostimulator to a model associated with each of the plurality of plug-in software drivers; determining that the model of other interrogated neurostimulator does not match any of the models associated with the plurality of plug-in software drivers; installing a new plug-in software driver on the system, wherein a model associated with the new plug-in software driver matches the model of the other interrogated neurostimulator; and programming the other interrogated neurostimulator via the new plug-in software driver.

Other and further aspects and features of the invention will be evident from reading the following detailed description of the preferred embodiments, which are intended to illustrate, not limit, the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings illustrate the design and utility of preferred embodiments of the present invention, in which similar elements are referred to by common reference numerals. In order to better appreciate how the above-recited and other advantages and objects of the present inventions are obtained, a more particular description of the present inventions briefly described above will be rendered by reference to specific embodiments thereof, which are illustrated in the accompanying drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

FIG. **1** is plan view of one embodiment of a spinal cord stimulation (SCS) system arranged in accordance with the present inventions;

FIG. **2** is a plan view of the SCS system of FIG. **1** in use with a patient;

FIG. **3** is a side view of an implantable pulse generator and a pair of stimulation leads that can be used in the SCS system of FIG. **1**;

FIG. **4** is a block diagram of the components of the clinician programmer that can be used in the SCS system of FIG. **1**; and

FIG. **5** is a flow chart of a method for programming a plurality of different models of neurostimulation devices.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The description that follows relates to a spinal cord stimulation (SCS) system. However, it is to be understood that while the invention lends itself well to applications in SCS, the invention, in its broadest aspects, may not be so limited. Rather, the invention may be used with any type of implantable electrical circuitry used to stimulate tissue. For example, the present invention may be used as part of neurostimulation system, such as a pacemaker, a defibrillator, a cochlear stimulator, a retinal stimulator, a stimulator configured to produce coordinated limb movement, a cortical stimulator, a deep brain stimulator, peripheral nerve stimulator, microstimulator, or in any other neural stimulator configured to treat urinary incontinence, sleep apnea, shoulder sublaxation, headache, etc.

Turning first to FIG. **1**, an exemplary SCS system **10** generally comprises a plurality (in this case, two) of percutaneous neurostimulation leads **12**, an implantable pulse generator (IPG) **14**, an external remote control (RC) **16**, a Clinician's Programmer (CP) **18**, an External Trial Stimulator (ETS) **20**, an external charger **22**, and a transceiver **23**.

The external charger **22** is a portable device used to transcutaneously charge the IPG **14** via an inductive link **38**. For purposes of brevity, the details of the external charger **22** will not be described herein. Details of exemplary embodiments of external chargers are disclosed in U.S. Pat. No. 6,895,280, which is expressly incorporated herein by reference.

The IPG **14** is physically connected via two lead extensions **24** to the neurostimulation leads **12**, which carry a plurality of electrodes **26** arranged in an array. The IPG **14** includes a replenishable power source, telemetry circuitry, and pulse generation circuitry that delivers electrical stimulation energy in the form of a pulsed electrical waveform (i.e., a temporal series of electrical pulses) to the electrode array **26** in accordance with a set of stimulation parameters. The IPG **14** and neurostimulation leads **12** can be provided as an implantable neurostimulation kit, along with, e.g., a hollow needle, a stylet, a tunneling tool, and a tunneling straw. Further details discussing implantable kits are disclosed in U.S. Patent Publication 2009/0216306, entitled "Temporary Neurostimulation Lead Identification Device," which is expressly incorporated herein by reference.

The ETS **20** may also be physically connected via percutaneous lead extensions **28** and external cable **30** to the neurostimulation leads **12**. The ETS **20**, which has pulse generation circuitry similar to that of the IPG **14**, also delivers electrical stimulation energy in the form of a pulsed electrical waveform to the electrode array **26** in accordance with a set of stimulation parameters. The major difference between the ETS **20** and the IPG **14** is that the ETS **20** is a non-implantable device that is used on a trial basis after the neurostimulation leads **12** have been implanted and prior to implantation of the IPG **14**, to test the responsiveness of the stimulation that is to be provided. Further details of an exemplary ETS are

described in U.S. Pat. No. 6,895,280, which has been previously incorporated herein by reference.

The RC **16** may be used to telemetrically control the ETS **20** via a bi-directional RF communications link **32**. Once the IPG **14** and neurostimulation leads **12** are implanted, the RC **16** may be used to telemetrically control the IPG **14** via a bi-directional RF communications link **34**. Such control allows the IPG **14** to be turned on or off and to be programmed with different stimulation programs after implantation. Once the IPG **14** has been programmed, and its power source has been charged by the external charger **22** or otherwise replenished, the IPG **14** may function as programmed without the RC **16** being present.

The CP **18** provides clinician detailed stimulation parameters for programming the IPG **14** and ETS **20** in the operating room and in follow-up sessions. The CP **18** may perform this function by indirectly communicating with the IPG **14** or ETS **20**, through the transceiver **23**. In particular, the CP **18** communicates with the transceiver **23** via a cable **33**, and the transceiver **23** communicates with the IPG **14** via a bi-directional RF link **36**, and with the ETS **20** via a bi-directional RF link **37**.

In the illustrated embodiment, the transceiver **23** is embodied as an external wand that connects to the CP **18** through a cable **33**. The cable **33** takes the form of a USB cable that includes connectors (not shown) on opposite ends to respectively connect to a USB port on the transceiver **23** and a corresponding USB port (not shown) on the CP **18**. Alternatively, the transceiver **23** may connect to the CP **18** through a bi-directional wireless (e.g., IR, RF, etc.) connection, or may be integrated into the CP **18**. The transceiver **23** is capable of being placed in proximity to the IPG **14** (e.g., within four feet), thereby allowing the CP **18** to program and receive status information from the IPG **14**.

Referring to FIG. **2**, the neurostimulation leads **12** are implanted within the spinal column **46** of a patient **48**. The preferred placement of the neurostimulation leads **12** is adjacent, i.e., resting near, or upon the dura, adjacent to the spinal cord area to be stimulated. Due to the lack of space near the location where the neurostimulation leads **12** exit the spinal column **46**, the IPG **14** is generally implanted in a surgically-made pocket either in the abdomen or above the buttocks. The IPG **14** may, of course, also be implanted in other locations of the patient's body. The lead extensions **24** facilitate locating the IPG **14** away from the exit point of the neurostimulation leads **12**. As there shown, the CP **18** communicates with the IPG **14** via the transceiver **23**. While the neurostimulation leads **12** are illustrated as being implanted near the spinal cord area of a patient, the neurostimulation leads **12** may be implanted anywhere in the patient's body, including a peripheral region, such as a limb, or the brain. After implantation, the IPG **14** is used to provide the therapeutic stimulation under control of the patient.

Referring now to FIG. **3**, some of the features of the neurostimulation leads **12** and the IPG **14** will be briefly described. One of the neurostimulation leads **12(1)** has eight electrodes **26** (labeled E1-E8), and the other stimulation lead **12(2)** has eight electrodes **26** (labeled E9-E16). The actual number and shape of leads and electrodes will, of course, vary according to the intended application. The IPG **14** comprises an outer case **40** for housing the electronic and other components (some of which are shown in phantom and described in further detail below), and a connector **42** to which the proximal ends of the neurostimulation leads **12** mate in a manner that electrically couples the electrodes **26** to the electronics within the outer case **40**. The outer case **40** is composed of an electrically conductive, biocompatible material, such as tita-

nium, and forms a hermetically sealed compartment for protecting the internal electronics from the body tissue and fluids. In some cases, the outer case **40** may serve as an electrode.

The IPG **14** includes a battery **44** and pulse generation circuitry **46** that delivers the electrical stimulation energy in the form of a pulsed electrical waveform to the electrode array **26** in accordance with a set of stimulation parameters programmed into the IPG **14**. Such stimulation parameters may comprise electrode combinations, which define the electrodes that are activated as anodes (positive), cathodes (negative), and turned off (zero), percentage of stimulation energy assigned to each electrode (fractionalized electrode configurations), and electrical pulse parameters, which define the pulse amplitude (measured in milliamps or volts depending on whether the IPG **14** supplies constant current or constant voltage to the electrode array **26**), pulse width (measured in microseconds), and pulse rate (measured in pulses per second).

Electrical stimulation will occur between two (or more) activated electrodes, one of which may be the IPG case **40**. Simulation energy may be transmitted to the tissue in a monopolar or multipolar (e.g., bipolar, tripolar, etc.) fashion. Monopolar stimulation occurs when a selected one of the lead electrodes **26** is activated along with the case **40** of the IPG **14**, so that stimulation energy is transmitted between the selected electrode **26** and the case **40**. Bipolar stimulation occurs when two of the lead electrodes **26** are activated as anode and cathode, so that stimulation energy is transmitted between the selected electrodes **26**. For example, electrode E3 on the first lead **12** may be activated as an anode at the same time that electrode E11 on the second lead **12** is activated as a cathode. Tripolar stimulation occurs when three of the lead electrodes **26** are activated, two as anodes and the remaining one as a cathode, or two as cathodes and the remaining one as an anode. For example, electrodes E4 and E5 on the first lead **12** may be activated as anodes at the same time that electrode E12 on the second lead **12** is activated as a cathode.

The IPG **14** also includes a hard drive **48** that stores programming data and identifying information. Examples of such identifying information stored on the hard drive **48** may include patient name, patient date of birth, hardware model, hardware serial number, firmware information, etc. When the IPG **14** is interrogated by the CP **18** via the transceiver **23**, hardware recognition occurs. That is, the hard drive **48** is accessed and the identifying information stored in the hard drive **48** is transmitted to the CP **18** via the transceiver **23**.

As briefly discussed above, the CP **18** greatly simplifies the programming of multiple electrode combinations, allowing the user (e.g., the physician or clinician) to readily determine the desired stimulation parameters to be programmed into the IPG **14**, as well as the RC **16**. Thus, modification of the stimulation parameters in the programmable memory of the IPG **14** after implantation is performed by a user using the CP **18**, which can indirectly communicate with the IPG **14** via the transceiver **23**. That is, the CP **18** can be used by the user to modify operating parameters of the electrode array **26**.

Referring back to FIG. **2**, the overall appearance of the CP **18** is that of a laptop personal computer (PC), and in fact, may be implemented using a PC that has been appropriately configured to include a directional-programming device and programmed to perform the functions described herein. Thus, the programming methodologies can be performed by executing software instructions contained within the CP **18**. Alternatively, such programming methodologies can be performed using firmware or hardware. In any event, the CP **18** may actively control the characteristics of the electrical stimula-

7   8

tion generated by the IPG **14** (or ETS **20**) to allow the optimum stimulation parameters to be determined based on patient feedback and for subsequently programming the IPG **14** (or ETS **20**) with the optimum stimulation parameters.

To allow the user to perform these functions, the CP **18** includes a mouse **72**, a keyboard **74**, and a display screen **76** housed in a case **78**. In the illustrated embodiment, the display screen **76** is a conventional screen. It is to be understood that in addition to, or in lieu of, the mouse **72**, other directional programming devices may be used, such as a trackball, touchpad, or joystick. Alternatively, the display screen **76** may be a digitizer screen, such as a touch screen (not shown), which may be used in conjunction with an active or passive digitizer stylus/finger touch.

A conventional CP is able to communicate with only one type, or model, of neurostimulation device. That is, because each model of neurostimulation device requires its own programming software package, switching from one model of neurostimulation device to another model required switching programming software packages.

A CP **18** in accordance with the present inventions is configured for programming a plurality of different models of neurostimulation devices as described in more detail below. Thus, regardless of which model of neurostimulation device a patient has, the CP **18** is capable of programming the patient's neurostimulation device. The "model" of neurostimulation device refers to the version, or generation, of the device. For example, a neurostimulation device may be a first generation device, a second generation device, a third generation device, etc. One of the advantages of the present invention is that the CP **18** is easily adapted to support future generations of neurostimulation devices.

As shown in FIG. **4**, the CP **18** in accordance with the present inventions generally includes a processor **80** (e.g., a central processor unit (CPU)) and memory **82** that stores a stimulation programming package **84**, which can be executed by the processor **80** to allow the user to program the IPG **14** or the ETS **20**. The CP **18** further includes output circuitry **86** for downloading stimulation parameters to the IPG **14** or the ETS **20**.

The CP **18** also includes a hard drive **88** and plug-in software drivers **90**. In the illustrated embodiment, the plug-in software drivers **90** are dynamic link library (DLL) plug-ins that act as "translators" between the neurostimulation devices (i.e., IPGs **14** or ETSs **20**) and the programming package **84**. Each different model, or generation, of neurostimulation device has its own specialized set of commands. The device driver DLL **90** for each model of neurostimulation device is configured to translate generic commands issued by the programming package **84** into the specialized commands understood by that model of neurostimulation device. The DLL plug-ins **90** are also configured to retrieve information from the neurostimulators, and transmit the information, properly translated, to the programming package **84**.

Thus, the DLL plug-in drivers **90** facilitate communication between the processor **80** operating in accordance with the programming package **84** and the different models of neurostimulation devices. By isolating this "translation" function in the DLL plug-ins **90**, new generations of neurostimulation devices are able to use the same programming package **84** as older generations of neurostimulation devices, so long as a DLL plug-in **90** corresponding to the new generation device is installed on the CP **18**. Thus, each new model of neurostimulation device does not require an entirely new programming software package. Rather, the new model of neurostimulation device just requires a new plug-in driver to be installed on the CP **18**, which is already being used to pro-

gram older versions of neurostimulation devices. Updates made to the driver do not affect the rest of the programming software package **84**. In this manner, the review and validation by the FDA and other such regulatory agencies of the new model of neurostimulation device and its associated software are streamlined.

Although three drivers **90(1)**, **90(2)**, and **90(3)** are depicted, it should be well understood that the CP **18** may include more or less drivers **90**. In particular, the number of drivers **90** corresponds to the number of neurostimulation device models that the CP **18** is configured to program. For example, if four generations of neurostimulation device models have been developed, the CP **18** would include four drivers **90** in order to be able to program each model of neurostimulation device. Each of the drivers **90** corresponds to one of the neurostimulation device models. As discussed in more detail below, based on an initial interrogation of a neurostimulation device, the processor **80** dynamically determines which model the interrogated neurostimulator is, and then chooses the software plug-in driver **90** corresponding to that model.

As shown in FIG. **4**, the drivers **90** are stored on the hard drive **88** of the CP **18**. However, because the drivers **90** are frequently accessed, upon start-up of the CP **18**, the drivers **90** are cached into memory **82**, as shown in phantom in FIG. **4**. Automatically caching the drivers **90** into memory **82** upon start up of the CP **18** improves processing speed because the drivers are quickly and easily accessed in the cache memory.

Execution of the programming package **84** by the processor **80** provides a multitude of display screens (not shown) that can be navigated through via use of the mouse **72**. These display screens allow the clinician to, among other functions, select or enter patient profile information (e.g., name, birth date, patient identification, physician, diagnosis, and address), enter procedure information (e.g., programming/ follow-up, implant trial system, implant IPG, implant IPG and lead(s), replace IPG, replace IPG and leads, replace or revise leads, explant, etc.), generate a pain map of the patient, define the configuration and orientation of the leads, initiate and control the electrical stimulation energy output by the leads **12**, and select and program the IPG **14** with stimulation parameters in both a surgical setting and a clinical setting. One of the advantages of the present invention is that these display screens, or user interfaces, are the same regardless of the model of the neurostimulation device being programmed. As such, clinicians comfortable with the user interface of the CP **18** will be able to program next generation and future generation neurostimulators because the user interface will remain the same. Further details discussing the above-described CP functions are disclosed in U.S. patent application Ser. No. 12/501,282, entitled "System and Method for Converting Tissue Stimulation Programs in a Format Usable by an Electrical Current Steering Navigator," and U.S. patent application Ser. No. 12/614,942, entitled "System and Method for Determining Appropriate Steering Tables for Distributing Stimulation Energy Among Multiple Neurostimulation Electrodes," which are expressly incorporated herein by reference.

FIG. **5** depicts a method **200** for programming a plurality of different models of neurostimulation devices using the system **10** shown in FIG. **1**. First, in step **202**, a neurostimulator is interrogated by the CP **18** via the transceiver **23**. The interrogated neurostimulator may by an IPG **14** or an ETS **20**. When the IPG **14** or the ETS **20** is in contact with the CP **18**, hardware information is uploaded to the CP **18** via the transceiver **23**. That is, during the interrogation, the hard drive of

the neurostimulator is accessed and identifying information about the neurostimulator is obtained from the hard drive and transmitted to the CP **18**.

Based on the identifying information, in step **204**, the processor **80** of the CP **18** determines the model of the interrogated neurostimulator. Next, in step **206**, the processor **80** compares the model of the interrogated stimulator to the model associated with one of the drivers **90**. Each one of the drivers **90** is associated with a different model of neurostimulation device. For example, driver **90(1)** may be associated with first generation neurostimulation devices, driver **90(2)** may be associated with second generation neurostimulation devices, driver **90(3)** may be associated with third generation neurostimulation devices, and so on. If the model associated with the driver matches the model of the interrogated stimulator (i.e., if the answer to decision block **208** is "yes"), then that driver is chosen in step **212**. For example, if the identifying information obtained from the interrogated neurostimulator indicates that the interrogated neurostimulator is a second generation device, driver **90(2)** would be chosen in step **212**. The chosen driver **90** is then used during programming of the interrogated stimulator in step **214**.

However, if it is determined in step **208** that the model associated with the driver does not match the model of the interrogated neurostimulator, then the comparison is performed with the next driver. The comparison step **206** is repeated with each driver **90** until a match is found between the model of the interrogated neurostimulator and the model associated with the driver.

If, in step **210**, it is determined that all of the drivers **90** have been compared to the model of the interrogated neurostimulator (i.e., if the answer to decision block **210** is "yes"), and no match was found, then a new driver is installed in step **216**. The model associated with the new driver matches the model of the interrogated neurostimulator. The new driver may be deployed to the CP **18** via any deployment methodology, such as by downloading, installing from a CD, installing from a thumb drive, or the like. Finally, in step **218**, the interrogated neurostimulator is programmed using the newly installed driver.

Although particular embodiments of the present inventions have been shown and described, it will be understood that it is not intended to limit the present inventions to the preferred embodiments, and it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the present inventions. Thus, the present inventions are intended to cover alternatives, modifications, and equivalents, which may be included within the spirit and scope of the present inventions as defined by the claims.

What is claimed is:

1. A method for communicating with one of a plurality of neurostimulation devices respectively of different models, the method comprising:
   caching a plurality of plug-in software drivers from a hard drive into memory, the plurality of plug-in software drivers respectively corresponding to the different models;
   selecting one of the plug-in software drivers from the memory; and
   communicating with the one neurostimulation device using the selected plug-in software driver.

2. The method of claim **1**, further comprising interrogating the one neurostimulation device, wherein the one plug-in software driver corresponding to the model of the interrogated neurostimulation device model is selected.

3. The method of claim **1**, further comprising programming the one neurostimulation device using the selected plug-in software driver.

4. The method of claim **3**, wherein the plug-in software drivers are dynamic link library (DLL) plug-ins, and the programming of the one neurostimulation device comprises issuing generic commands, and using the chosen DLL plug-in to translate the generic commands into specialized commands to program the neurostimulation device.

5. A method for communicating with one of a plurality of neurostimulation devices respectively of different models, the method comprising:
   interrogating the one neurostimulation device;
   determining the model of the interrogated neurostimulation device;
   selecting one of a plurality of plug-in software drivers respectively corresponding to the plurality of different models, wherein the one plug-in software driver is selected based on the determined one neurostimulation device; and
   communicating with the one neurostimulation device using the selected plug-in software driver.

6. The method of claim **5**, further comprising programming the one neurostimulation device using the selected plug-in software driver.

7. The method of claim **5**, further comprising downloading information from the one neurostimulation device using the selected plug-in software driver.

8. The method of claim **5**, wherein interrogating the one neurostimulation device comprises accessing a hard drive of the one neurostimulation device and obtaining identifying information from the hard drive of the one interrogated neurostimulator.

9. The method of claim **5**, wherein selecting the one plug-in software drivers comprises:
   comparing the model of the interrogated neurostimulator to the model associated with the plug-in software drivers;
   determining that the model of the interrogated neurostimulator matches one of the models associated with one of the plug-in software drivers; and
   selecting the plug-in software driver associated with the matching model.

10. The method of claim **5**,
   interrogating another one of the neurostimulation devices;
   determining the model of the other interrogated neurostimulation device;
   selecting another one of a plurality of plug-in software drivers based on the determined one other neurostimulation device; and
   communicating with the one other neurostimulation device using the other selected plug-in software driver.

11. The method of claim **5**, further comprising, before interrogating the one neurostimulation device, caching the plurality of plug-in software drivers from a hard drive into memory.

12. The method of claim **5**, wherein the plug-in software drivers are dynamic link library (DLL) plug-ins, and the programming of the one neurostimulation device model comprises issuing generic commands, and using the chosen DLL plug-in to translate the generic commands into specialized commands to program the neurostimulation device model.

13. A method for communicating with one of a plurality of neurostimulation devices respectively of different models, the method comprising:

interrogating the one neurostimulation device;

determining the model of the interrogated neurostimulation device;

selecting one of a plurality of plug-in software drivers respectively corresponding to the plurality of different models, wherein the one plug-in software driver is selected based on the determined one neurostimulation device;

communicating with the one neurostimulation device using the selected plug-in software driver;

programming the one neurostimulation device using the selected plug-in software driver; and

downloading information from the one neurostimulation device using the selected plug-in software driver.

14. The method of claim **13**, wherein interrogating the one neurostimulation device comprises accessing a hard drive of the one neurostimulation device and obtaining identifying information from the hard drive of the one interrogated neurostimulator.

15. The method of claim **13**, wherein selecting the one plug-in software drivers comprises:

comparing the model of the interrogated neurostimulator to the model associated with the plug-in software drivers;

determining that the model of the interrogated neurostimulator matches one of the models associated with one of the plug-in software drivers; and

selecting the plug-in software driver associated with the matching model.

16. The method of claim **13**,

interrogating another one of the neurostimulation devices;

determining the model of the other interrogated neurostimulation device;

selecting another one of a plurality of plug-in software drivers based on the determined one other neurostimulation device; and

communicating with the one other neurostimulation device using the other selected plug-in software driver.

17. The method of claim **13**, further comprising, before interrogating the one neurostimulation device, caching the plurality of plug-in software drivers from a hard drive into memory.

18. The method of claim **13**, wherein the plug-in software drivers are dynamic link library (DLL) plug-ins, and the programming of the one neurostimulation device model comprises issuing generic commands, and using the chosen DLL plug-in to translate the generic commands into specialized commands to program the neurostimulation device model.

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